THE IMPORTANCE OF OFFLOADING

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'Offloading' is the transfer of pressure and stress away from the point at which it might cause pain, distress or further injury, onto other parts of the structure that can better take the pressure or stress.

The foot is designed to take dynamic body weight and work under static or dynamic intermittent load. This is all very well when the structure is properly formed and the stress to which it is exposed is of the normal magnitude and from the expected direction. But in the event of some pathological lesion arising, the foot or a part of the foot may need to be defended against stress for which it is not designed. The ability to 'offload' must be a fundamental part of our skill set. It is widely recognised that increased peak plantar pressure often precedes ulceration, leading to the prospect of amputation.

The most important drive behind increased plantar pressure or excessive weight being imposed upon localised parts of the foot is hyperpronation. The great majority of plantar misalignments and misdirected pressures are generated by anatomical disruption incurred by excessive pronation of the foot. Management of hyperpronation is probably the most important and most effective single intervention in management of foot pain and improvement of foot function. <u>This is the first pathology to address</u>.

The mechanisms by which we might offload are worthy of consideration, preparation and practice. Indeed, offloading is one of the most important aspects of practice. Taking the foot one zone at a time allows us to examine the need and some of the options….

Apices of toes

The apex of each digit is here defined as that part of the toe which constitutes the 'tip' and the pulp plantar to the nail. The apex is loaded in normal gait only at the point at which the foot becomes unguligrade (literally *'on the nails'*). This occurs normally for a very brief interval immediately before 'toe-off'. Excessive or prolonged load upon the apices occurs in those who must raise their heel earlier or higher than usual – those who suffer equinus (lack of dorsiflexion ability), intoeing, adducted, cavus feet or those with retracted toes where the apices are directed towards the ground surface, or those with restriction of movement of the metatarsophalangeal joints that prevent the digits escaping load by dorsiflexion of the toes. Regular stress upon the apices is also applied by short shoes, or shoes in which the foot elongates excessively, producing forced contact with the inside of the toe-cap.

- Pressure on the apices can be relieved offloaded by anti-elongation, anti-pronatory measures - rearfoot control and support of the medial arch – orthoses – where the in-shoe volume allows.
- A metatarsal bar can be placed beneath the metatarsal heads to enable heel-lift before the apices are loaded.
- A plantar prop 2-5 will share the weight that would otherwise be imposed entirely upon the apices of the lesser toes with the plantar surfaces of those toes.
- Silicone orthodigita can be designed to extend or align one or more digits, or prevent concentration of shoe pressure upon a specific locality.

Metatarsal heads and fibro-fatty metatarsal pad area

Individual metatarsal heads may become prominent in the event of plantar plate rupture. Where the toes are severely retracted the fibro-fatty pad can be pulled forward by its attachment to the proximal phalanges, so that the pad occupies the space beneath the retracted toes and can no longer protect the metatarsal heads. In diabetes, the nature of the fibro-fatty pad stiffens, reducing its ability to conform and shock-absorb. Sometimes, particularly with advanced age, the fibro-fatty pad undergoes atrophy leaving insufficient tissue for protection of the bones beneath.

- Metatarsal pads can be designed to relieve the weight taken on vulnerable metatarsal heads.

- Individual metatarsal heads can be accommodated by provision of relief chambers, circular or 'U'-shaped cut-outs. Those made in semi-compressed white felt will compress by 50% when worn, so they need sufficient thickness to functionally elevate the area following compaction.
- If the fibro-fatty pad has, or ceases to have sufficient tissue to provide adequate protection, there is need of tissue augmentation or tissue replacement – preferably by use of non-collapsing, self-restoring materials (latex foam, Poron, Sorbothane, etc).

First metatarsophalangeal joint – plantar aspect

The first metatarsal bone is designed to plantarflex as the foot pronates in preparation for toe-off, and in so-doing the plantar fascia is wound around the head of the 1st metatarsophalangeal joint, drawing the rearfoot towards the forefoot, raising the medial longitudinal arch and causing close approximation of the bones of the medial column. Two sesamoid bones are developed in the tendon of Flexor hallucis brevis (FHB), immediately beneath the 1st met head and they slide in grooves separated by a bony ridge – the crista. If the crista becomes worn or is flattened, the sesamoids slip out of the grooves and the FHB 'bowstrings'. This means that the guidance of Flexor hallucis longus (FHL) is also lost, its contraction adding to abduction forces that displace the hallux, contributing to the development of Hallux abductovalgus….

According to Root *et al,* (1977), *'biomechanically the sesamoids assume a more distal position as the first ray plantar flexes and moves posteriorly. The pulley system becomes activated at heel-off, and the first metatarsal head glides proximally on the sesamoid apparatus'.*

> *'The function of the sesamoids is to absorb and disperse weight bearing from the metatarsal head. This function in turn provides protection to the flexor hallucis longus (FHL) tendon. The sesamoids serve to increase the moment arm of the flexors, increasing their power and supplementing the mechanical advantage of first MPJ motion. The sesamoids are invested within the FHB tendons and function to absorb shock and enhance the gliding function of the joint.'* (Judge, 2011).

Due to the functional role it fulfils in gait and when standing on tip-toe, the first MPJ takes considerable load, often leading to the formation of Heloma durum and callus on the plantar surface beneath the joint. The joint often becomes arthritic and stimulation of bone growth produces Hallux limitus, which readily progresses to Hallux rigidus. The joint can become the focus of gout and is a common site of diabetic ulceration.

- The plantar first MPJ is best offloaded by use of orthoses - the variation described by Dananberg, DPM is furnished with a groove to facilitate 1st ray plantarflexion
- metatarsal pads with cut-outs for the first met head or metatarsal bars 2-5 can be utilised to offload much of the weight that would otherwise be imposed on the joint
- A Frelen insole can readily be modified to present a pressure relief area beneath a lesion

First metatarsophalangeal joint – medial aspect

The prominence of the medially displaced head of metatarsal/base of proximal phalanx of the hallux is a site that often receives excess pressure – leading to the formation of the adventitious bursa popularly known as the 'bunion'.

- Alignment of the hallux can be improved by insertion of gel spacers or silicon orthodigital toe separators between the hallux and 2nd toe (this does nothing to re-align the 1st metatarsal)
- Crescentic pads placed behind the prominence, or cavity pads placed over the joint seek to prevent pressure falling upon the lesion and re-direct that pressure to the metatarsal shaft area.

First metatarsophalangeal joint – dorsal aspect

- Pads may be designed to carry pressure over and around the sensitive prominence. Pads in this position might be held in place beneath a broad elastic band that encircles the foot.

Styloid process – base of 5th metatarsal

The lateral projection of the process is sometimes excessively prominent and is a regular site of diabetic ulceration.

- A 2cm wide strip of s/c white felt may be placed within the shoe before and behind the process to hold the shoe away from the lateral foot.

Heel pad - plantar

Pain in the heel region is usually associated with plantar fasciopathies. The aim should be to offload the centre of the heel pad by creating a 'seating' beneath the rim of the heel - the pressure is thus reduced at the centre of the heel pad.

- A pad could be adhesively attached to the heel, but consider instead adhering the pad into the shoe, either directly, or by placing the seating beneath an insole such as a 'Frelen'.

Heel - posterior

Posterior heel pain is often generated by the frontal plane action in gait of the heel against the footwear. Instability of the heel within the footwear can lead to the formation of a 'Haglund's bump', as the top edge of the shoe is made to 'saw' at the tendo-Achilles.

- Semi-compressed white felt can be cut into a 'U'-shape and adhered to the foot or placed within the shoe to prevent direct irritation. Several gel and rubber-waffle appliances are designed for this very purpose.
- Position a wedge beneath the heel to address the frontal plane instability.
- Consider orthotic provision.

Offloading alleviates direct pressure upon a site and prevents the de-vascularisation that would otherwise occur – it aims to maintain the local blood supply when the foot bears weight. Maintenance of the local blood supply ensures that the tissues continue to receive adequate perfusion, delivery of nutrition and oxygenation, and the removal of metabolic toxins.

Offloading can be achieved by a range of strategies - from padding placed close to a potential pressure point to improvement of posture and gait pattern.

Offloading can be achieved by:

- placing of well-designed dressings to redirect forces applied to the foot
- absorption, attenuation and dissipation of traumatic forces by cushioning to decelerate, spread the force applied over a longer time-span, or spread the force over a greater area, or
- prevention from the generation of traumatic forces or reduction of the magnitude of traumatic forces by re-alignment/correction of postural stance and aberrant gait patterns.

Offloading can be:

- directly adhered to the foot
- placed within the shoe
- achieved by the employment of insoles or orthoses.

Look at the area that needs protection – ask the questions:

'how can the area be defended?'
'what are the options?'
'which is most appropriate option in this case?'

References:

Root ML, Orien WP, Weed JH, *et al*. Normal and abnormal function of the foot, clinical biomechanics, vol. II. Los Angeles (CA): Clinical Biomechanics; 1977 in: Sesamoid Disorders of the First Metatarsophalangeal Joint. Allan Boike DPM, Molly Schnirring-Judge DPM, Sean McMillin DPM.

Sesamoid Disorders of the First Metatarsophalangeal Joint. Allan Boike DPM, Molly Schnirring-Judge DPM, Sean McMillin DPM. Clin Podiatr Med Surg - (2011) doi:10.1016/j.cpm.2011.03.006 Published by Elsevier Inc.

THE ALLIANCE PROFESSIONAL DEVELOPMENT PROGRAMME

OFFLOADING

Answers should be submitted on A4 paper and should be of sufficient length to demonstrate full understanding of the topic. Single word answers are not permissible. Try to answer in one or two short paragraphs, not more than a ¼ page per answer.

Q1. Define 'offloading'. What is its primary aim?

Q2. How might excessive pressure be applied to the apices of the lesser toes? Examine the strategies that might be used to defend the apices of the lesser toes.

Q3. Describe an offloading strategy for the relief of pressure on the plantar aspect of the 1st MPJ.

Q4. How would you defend an adventitious bursa in a case of Hallux abductovalgus?

Q5. Apply the principals of offloading to the central heel pad… describe how you could relieve pressure upon the area whilst allowing weightbearing.

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